RAILWAY ENGINEERING

AND MAINTENANCE OF WAY

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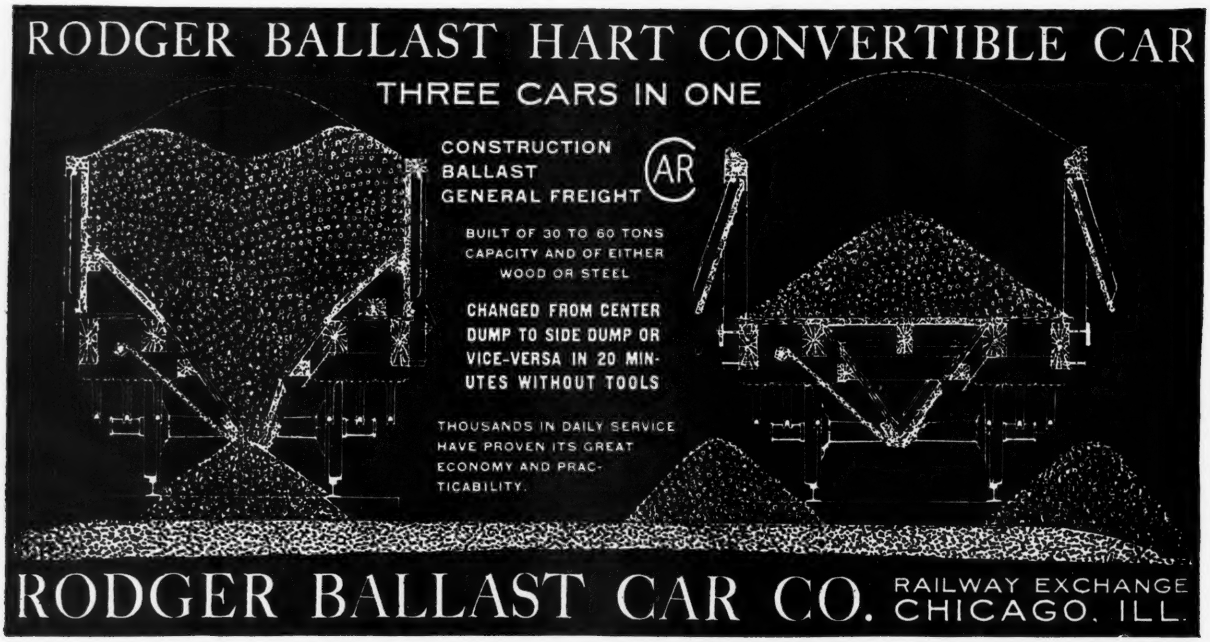

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and Maintenance of Way

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CONTENTS.

Track Tests

IN order to design track and roadbed, which shall meet efficiently the requirements with steam or electric locomotives, the Pennsylvania railroad has been making a series of tests near Clayton, N. J. This data will be of unusual value because there is much doubt as to the accuracy of the estimates of pressures against the rails which were obtained theoretically. The element of friction entered into such calculations and its effect was unknown. The only solution to this problem was in the actual testing under practical conditions.

The track for these tests was laid on steel ties, the rails being attached with a block which allowed a slight movement of the rail. The force with which the flanges of the wheels pressed against the rails was registered by this movement. Both steam and electric locomotives were tested on tangents and curves.

The experimental determination of values for constants, which enter into the problem of rail presures, will tend to produce a track of practical design which shall give every assurance of safety.

The Cement Show

THE first cement show of the Cement Products Exhibition Company, held last month in Chicago, was attended with success. The exhibits were very interesting as well as the technical papers which were worked out in conjunction with the Northwestern Cement Products Association.

The exhibits covered almost every use to which cement is adapted and many of these were very practical because the application of the material was shown by examples. The various designs of reinforcing rods and the several systems of reinforcement were illustrated and their points of merit explained by the exhibitors.

Contractors' supplies, such as mixers, derricks, dump cars, wheelbarrows, graders, scrapers, etc., were on exhibition. The contractor and builder were able to find all the necessary machines, appliances and tools that go to make up a complete equipment. As a concrete show it was very complete and therefore decidedly satisfactory.

The program included papers by practical men on many subjects in the field of cement and concrete construction. Among the papers were some on reinforced concrete, concrete forms and concrete pipe. Many of the exhibits and technical papers were of interest to the railroad men.

Collisions and Derailments

THE records of the Interstate Commerce Commission show an increase in the number of casualties for the year ending June 30, 1907, over the three previous years. The total number of passengers and employees, both killed and injured, has increased each year, but this is due in the main to the great expansion of railroad traffic and can not be taken as an indication of poorer facilities for safeguarding traffic.

The casualties to passengers in train accidents amounted to 410 killed, but of this number 291 deaths resulted from 10 accidents of which 5 were collisions, 4 were derailments and 1 was an explosion. Three of the above mentioned accidents were unexplained, but the others were due to neglect of signals or poor supervision on the part of some individual.

It is expected, however, that the effective methods of signalling, which are being introduced, will have a tendency to reduce the number of accidents. Had signalling not been developed up to its present standard, there would no doubt have been an overwhelming increase in accidents with the advent of higher speeds and heavier traffic.

The small increase in the number of coupling accidents and those occurring to men on tops of freight cars is attributed to better maintenance and care of automatic couplers and the increased use of air brakes.

Of the total number of accidents in the past year 8,026 of the 15,458 were classed as collisions and the remaining 7,432 as derailments. By far the greater number of derailments were due to defects of roadway and equipment and very few were due to negligence of trainmen, signalmen, etc.

While the number of accidents would be expected to increase with railroad expansion, the records indicate that the number is variable and depends upon unforeseen conditions which arise from time to time. It may be assumed that the improvements in track, roadbed and signalling appliances will decrease the number of collisions and derailments of the general order that they will not at least increase in the future in proportion to railroad extension.

Railroad Development

WITHIN the past year railroad construction work has been very extensive throughout the country. Lines were extended and improvements made in track and roadbed to handle traffic more quickly and economically. Where steep grades and sharp curves were eliminated and the track and roadbed renewed to handle the heavier rolling stock and greater traffic, very often heavy and costly improvements were necessitated, but years of experience testify to the fact that it pays to make them.

Outside of track and roadbed construction, new shops have been built to handle the increased equipment of the roads. In this connection the use of reinforced concrete may be noted. This building material is used in many of the shop buildings and in some it has entered into the construction to such an extent that they may be termed concrete structures. Where enormous loads must be carried it is not applicable for several reasons among which are the large size of columns, girders and beams and the cost of material incurred thereby. It is used advantageously in many places, however, and it is thought that the use of concrete will become more general in railroad shop construction.

In connection with track work much new equipment has been introduced, in which the steel tie is prominent. The steel tie may be used very extensively on account of its durability and, as the wood tie becomes more and more costly with the decreasing supply of timber, it may become an actual necessity. Besides this, there are many new designs of track devices which are of value in improving track construction.

Another field in which much progress has been made in the past year is that of signalling. The efficiency of new appliances has been increased until the automatic block system may be depended upon to safeguard traffic satisfactorily.

The development in design and construction will continue for many years to come. It is our endeavor to keep our readers informed as to the progress which is made. The field is very large and therefore it may not always be covered in a single issue, but it is our intention to give our readers a record of present practice in the several branches of the engineering department. In order to do this efficiently it may be necessary to ask assistance of some readers as has been done in the past. These favors were greatly appreciated as will assistance rendered in the future.

Reinforced Concrete Beams

THE data, which has been obtained concerning reinforced concrete beams, is very extensive and much of it may be applied practically, yet the investigation is not complete. A series of tests was conducted at the Engineering Experiment Station, University of Illinois, to supply additional information on the effect of quality of concrete, the effect of method of loading, the effect of repetitive loading and diagonal tension failures. This data has been embodied in bulletin No. 14, and while it is not claimed to be fully conclusive, the information warrants careful consideration.

In the discussion of the tests of beams in which the variation was in the richness of the concrete, it was noted that the beams with a larger proportion of cement sustained greater loads with the same percentage of steel and that beams of richer concrete provided for greater shearing stresses. The results of these tests show that better construction is had by the use of a 1-2-4 concrete than a 1-3-6 concrete. While reinforcement for shearing stresses was not introduced, it may be assumed that richer concrete would assist materially in preventing failure by diagonal tension.

A few tests were made to determine the effect of repetitive loading. It was found that the deflections of the beam increased with successive applications of the load. The repeated load varied between 50 and 85 per cent of the maximum load carried by the beam. The tests were not of such extent that definite conclusions could be drawn, because only a few beams were tested, the repeated loads were too high and the number of applications of the load were insufficient. Tests of this nature were made at Washington University under the direction of Prof. J. L. Van Ornum and it was found that

there was only a slight variation from a plane section for working loads with a decided departure for higher loads. The neutral axis of the beam was also found to vary between 42 and 32 per cent of the effective depth of the beam.

In the forty tests where failure resulted from diagonal tension, it was found that higher stresses were sustained by the richer concretes. The importance of the location of stirrups in order to make the web reinforcement effective was emphasized by the tests on those beams in which U-shaped stirrups were placed. The efficiency of web reinforcement was not, however, determined, but it was noted that the stirrups prevented sudden failure. It did not appear that the failures by diagonal tension were influenced by a lack of bond between concrete and steel.

In a later bulletin of the University of Illinois Experiment Station, further investigation along similar lines will be presented. The advantages obtained from data of this nature lie in its application to practical work, and in order to use the data in this manner it is necessary that the investigation be complete in every detail.

Locomotive and Car Shops

Kansas City Southern Railway, Pittsburg, Kas.

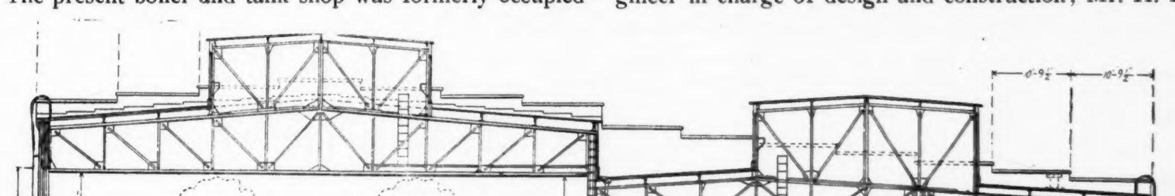
THE Kansas City Southern Railway is a trunk line operating from Kansas City, Mo., to Port Arthur, Texas. The total mileage of the road is 844, of which 786 miles are main line. The principal repair shops of the road are located at Pittsburg, Kan., 129 miles from the northern terminus and at Shreveport, La., 220 miles from Port Arthur or the southern terminal of the road.

In the past few years the road has enjoyed unprecedented prosperity, as it offers a southern outlet to the gulf for the roads centering at Kansas City. With the additions made to equipment and the increase in traffic on the road, the old repair shops and facilities became inadequate. Recently the shops at Pittsburg, Kan., have been remodeled and enlarged to cope with the greater volume of repairs necessary.

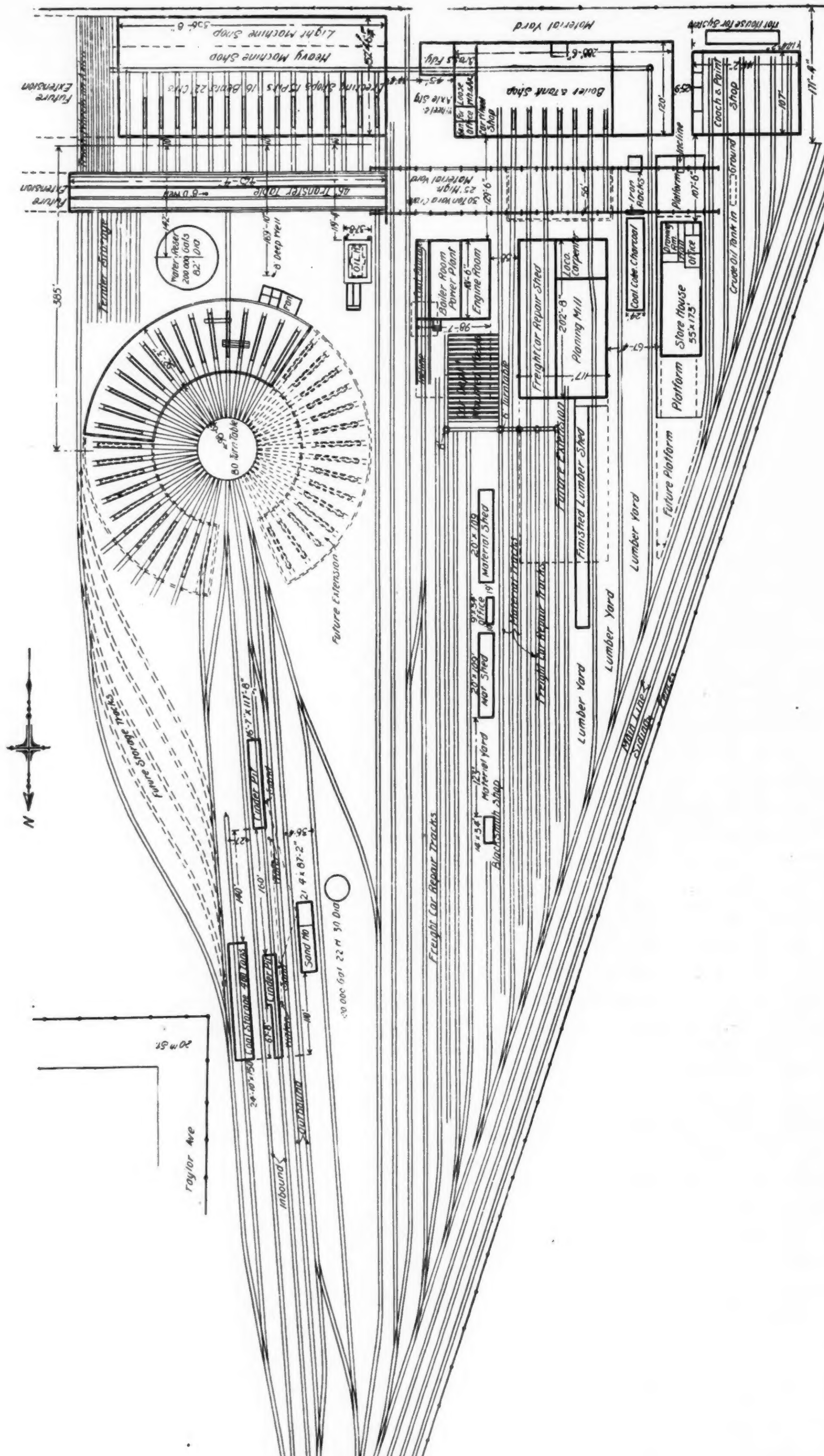
The problem of rearranging the general layout and providing certain new buildings presented an interesting study. The location of the old buildings that were to be continued in service, placed certain restrictions and any plans to provide for the layout as a whole were governed by the original layout and by property limitations. The present boiler and tank shop was formerly occupied by the machine and erecting shop and the former roundhouse was located on the site occupied by the present machine and erecting shop.

The new work includes the present roundhouse and terminal facilities, machine and erecting shop, power house, oil house, transfer table and yard crane, together with the incorporation of a number of modern facilities improving the plant.

The plans for remodeling the shops were prepared by the Arnold Company, acting in co-operation with the engineering and mechanical officials of the railway company and the construction of the entire plant was carried to completion by the Arnold Company. The work throughout was subject to the approval, for the railway company, of Mr. J. E. Edson, president, and Mr. W. Coughlin, general manager, Mr. A. F. Rust, resident engineer, directly supervising, and Mr. F. Mertsheimer, superintendent of machinery, representing the mechanical department; Mr. R. M. Galbraith occupying the latter position near the completion of the work. The Arnold Company was represented by Mr. P. L. Battey, engineer in charge of design and construction; Mr. H. H.



CROSS-SECTION OF MACHINE AND ERECTING SHOP—KANSAS CITY SOUTHERN RAILWAY, PITTSBURG, KANS.



GENERAL LAYOUT OF LOCOMOTIVE AND CAR SHOPS AT PITTSBURG, KANS.—KANSAS CITY SOUTHERN RAILWAY.

Dickinson, superintendent, and Mr. H. L. Senger, resident engineer.

While not as extensive as a number of new shops constructed within the last few years, the work of remodeling this plant is of unusual interest as illustrating some of the provisions necessary in disposing of old shops and arranging for an intimate relation between the various departments to increase the efficiency of the plant as a whole. The new buildings erected and the additional facilities provided are representative of experience gained from modern railway shops. In the ensuing article the layout of the entire plant will be considered as a whole and the features of the new work will be taken up individually.

LAYOUT.

The principle advanced in the general layout provides as fundamental the arrangement of all buildings tributary to a main avenue of distribution. Storage spaces and minor avenues of distribution are tributary to the midway and while the shop plant is very compact, departments are by no means crowded. The minimum distance between old buildings is about 26 feet and there is ample yard space tributary to each building to provide for the storage of material carried in stock. The midway includes a transfer table pit 425 feet 4 inches long and a crane served runway 460 feet long. These overlap for a distance of 22 feet in order that material may be conveniently transferred from the crane to the transfer table and vice versa. The transfer table pit is 46 feet wide and the span of the crane is 56 feet.

The transfer table is operated by two motors of 15 h. p. each, operated at 150 feet per minute when loaded and attaining a speed of 350 feet per minute light.

The double trolley crane over the material yard has a capacity of 30 tons and the crane runways are 25 feet high. A general system of yard tracks at right angles with the midway and nearly parallel with the main line serve all departments and is connected to the main line at one end of the shop yard.

The erecting and machine shop, boiler and tank shop, blacksmith shop and the coach and paint shop are ranged along the south side of the midway with the storehouse, planing mill, freight car repair shed, power house, oil house and roundhouse on the north side of the midway.

The freight car repair tracks are beyond the power plant and planing mill so situated as to be easy of access from the planing mill and storehouse. Access to the repair tracks is by leads at one end of the yard, which connect with the main line. The repair tracks are arranged in two groups with a material yard, two material sheds, foreman's office and blacksmith shop between the groups. The repair tracks are evenly spaced on 24-foot centers with standard gauge material tracks midway between the working tracks. At the stub ends of material tracks cross movement of wheels and material is provided for by a short intersecting track having a 6-foot turntable at each intersection. Adjacent to this intersecting track is a storage space for mounted car wheels.

Engine pits in the erecting and machine shop are arranged transversely and are served by the transfer table. The erecting shop is at one end of the midway immediately opposite to the roundhouse. Communication between the roundhouse and the erecting shop is by means of a straight track from the turntable to the transfer table. Driving wheel and truck wheel drop pits are tributary to this track to facilitate the prompt delivery of wheels removed from locomotives in the roundhouse. Space beyond the erecting and machine shop tributary to the transfer table is provided for the storage of truck wheels on axles, while space on the opposite side is reserved for tender storage.

The boiler and tank shop is situated just west of the erecting and machine shop and is tributary to the crane served yard. The foreman's office occupies one corner and a wing for brass foundry and shop for car wheel work are included in this shop building. While the distribution of heavy material is provided for by the yard crane and transfer table, light material may be delivered over a standard gauge industrial track which extends through the erecting and machine shop, boiler and tank shop and the blacksmith shop. In the blacksmith shop a standard gauge yard track intersects with this distribution track and a 6-foot turntable is located at the intersection.

The blacksmith shop occupies a position at one end of the boiler and tank shop having a dividing wall between the two shops. The output of the blacksmith shop is consumed by both the locomotive and car departments and while its position is not central, it is so situated as to provide for the distribution of material over a direct route to both departments, as well as to the roundhouse.

The coach and paint shop occupies a position beyond the blacksmith shop, the space between being used for a storage yard. This shop is arranged transversely and access to the working tracks is by means of a ladder connected with the yard tracks.

The storehouse is at one side of the territory occupied by shop buildings where the storehouse platform may be served by two tracks and where a string of cars on the storehouse track will not offer any obstruction to general yard traffic. The platform at one end is within the range of the yard crane so as to facilitate delivery either from the storehouse to any of the shop buildings or from any of the manufacturing shops to the storehouse.

The planing mill and freight car repair shed are side by side, with a common wall between them and both are tributary to the freight car repair tracks. North of the planing mill is a finished lumber shed.

The power plant occupies a position practically at the center of the plant and at the center of distribution. It is almost an equal distance from the erecting and machine shop, the boiler shop and the planing mill, the three shops consuming the greatest amount of power and

at the same time it is located convenient to the planing mill from which provision is made for the delivery of shavings, scrap lumber, etc., for use as fuel.

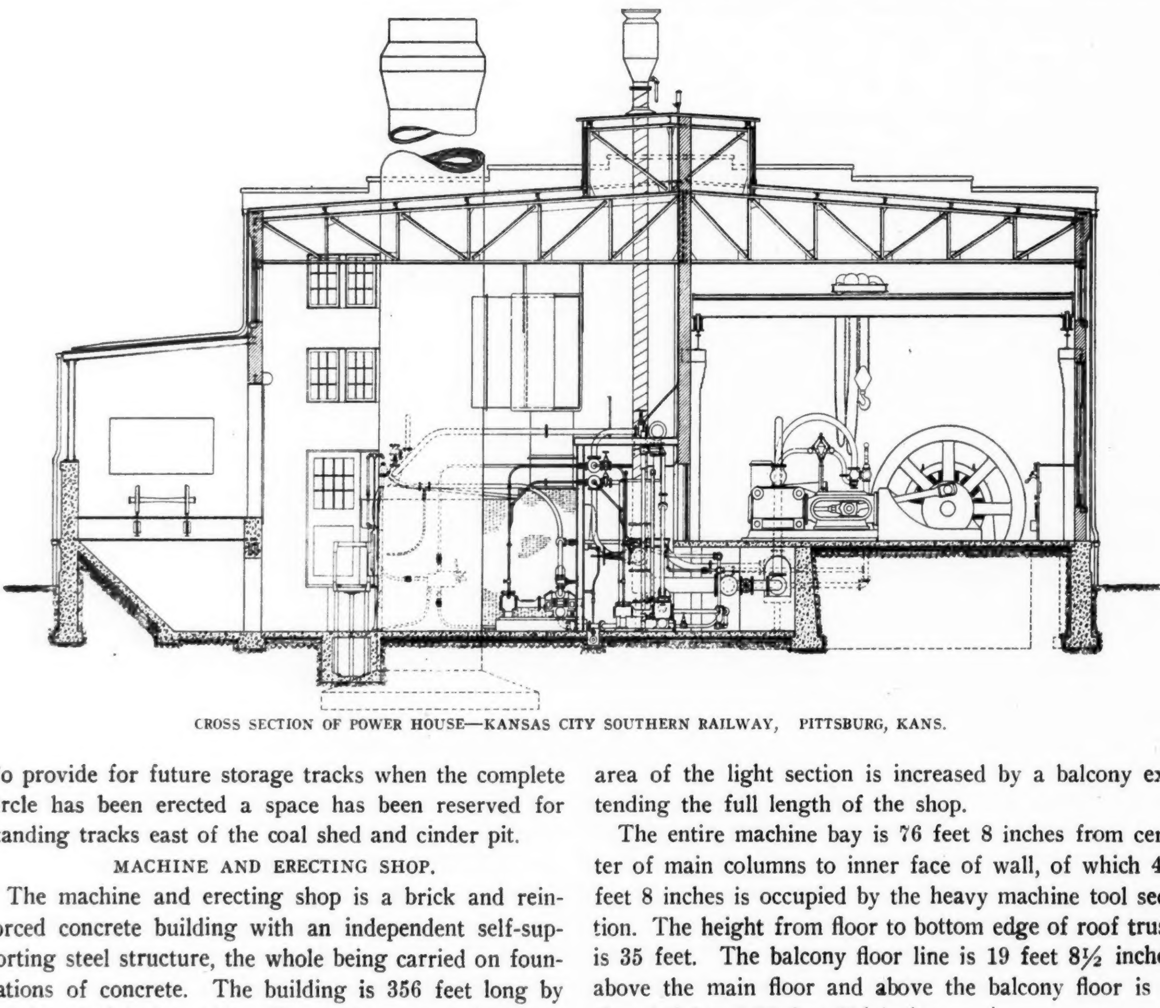
The oil house is in an isolated building near the roundhouse, where it is conveniently situated for the delivery of oil, waste, etc., to engines turned at this terminal.

The roundhouse as erected for present needs includes fifteen stalls. However, provision is made for the complete circle to contain forty-one stalls, as future requirements may demand. In connection with the roundhouse a modern locomotive terminal has been provided, with large coal and sand handling facilities, cinder pits and inspection pit. For the present, tracks radiating from the roundhouse turntable will be used for the storage of locomotives not requiring to be placed in the house.

floor and one track at the extreme east end of the building from which the usual pit is omitted. The pits are 43 feet long, arranged on 22-foot centers.

The erecting floor is 71 feet 9 inches wide between centers of crane columns. The height from floor to bottom chord of roof truss is 41 feet 6 inches and the height from floor to top of crane rail is 30 feet.

The machine floor occupies a bay parallel with and adjacent to the erecting floor. It is divided into two sections, the division being marked by the row of columns carrying the crane girders for the machine floor crane, and the balcony girders. The section next to the erecting floor is for heavy machine work, while the further section is for light machine work and for the accommodation of the auxiliary departments. The floor



CROSS SECTION OF POWER HOUSE—KANSAS CITY SOUTHERN RAILWAY, PITTSBURG, KANS.

To provide for future storage tracks when the complete circle has been erected a space has been reserved for standing tracks east of the coal shed and cinder pit.

MACHINE AND ERECTING SHOP.

The machine and erecting shop is a brick and reinforced concrete building with an independent self-supporting steel structure, the whole being carried on foundations of concrete. The building is 356 feet long by 152 feet 2¼ inches wide. The roof trusses include two principal spans, one over the erecting bay and one over the heavy machine bay, with a short truss over the light machine bay.

Ample natural light is provided for by large windows in the side and end walls, by swinging sash carried in the sides of the monitor over each bay and by fixed clerestory sash in the structure of the erecting bay extending above the roof of the machine bay.

There are 15 transverse working pits in the erecting

area of the light section is increased by a balcony extending the full length of the shop.

The entire machine bay is 76 feet 8 inches from center of main columns to inner face of wall, of which 46 feet 8 inches is occupied by the heavy machine tool section. The height from floor to bottom edge of roof truss is 35 feet. The balcony floor line is 19 feet 8½ inches above the main floor and above the balcony floor is a clear height of 15 feet 3½ inches.

The general foreman's office is elevated above the floor, supported by the balcony structure, and extending out into the heavy machine section it occupies a position practically at the center of the machine floor, whence a commanding view may be had of the machine department.

The erecting floor is served by a crane of 120 tons capacity having a span of 71 feet 4½ inches. The lowest portion of the crane girder is 30 feet above the floor,

of sufficient height to transfer a boiler above engines standing on the erecting pits.

The heavy machine section is served by a crane of 10 tons capacity having a span of 42 feet $1\frac{1}{2}$ inches. The top of the crane rail is 28 feet $9\frac{1}{2}$ inches above the floor and the crane runway girders are supported on brackets carried by the columns supporting the roof structure.

BOILER AND TANK SHOP.

The present boiler and tank shop was originally used for the machine and erecting shop. It contains seven transverse working pits in addition to an entering track at one end. One end of the shop is occupied by the office of the foreman, a car wheel and axle shop and a brass foundry. The brass foundry occupies the space formerly devoted to the original power house. The erecting floor occupies the section of the building toward the yard crane and the floor in the parallel bays is used for machine work, steel plate work, laying out, etc.

BLACKSMITH SHOP.

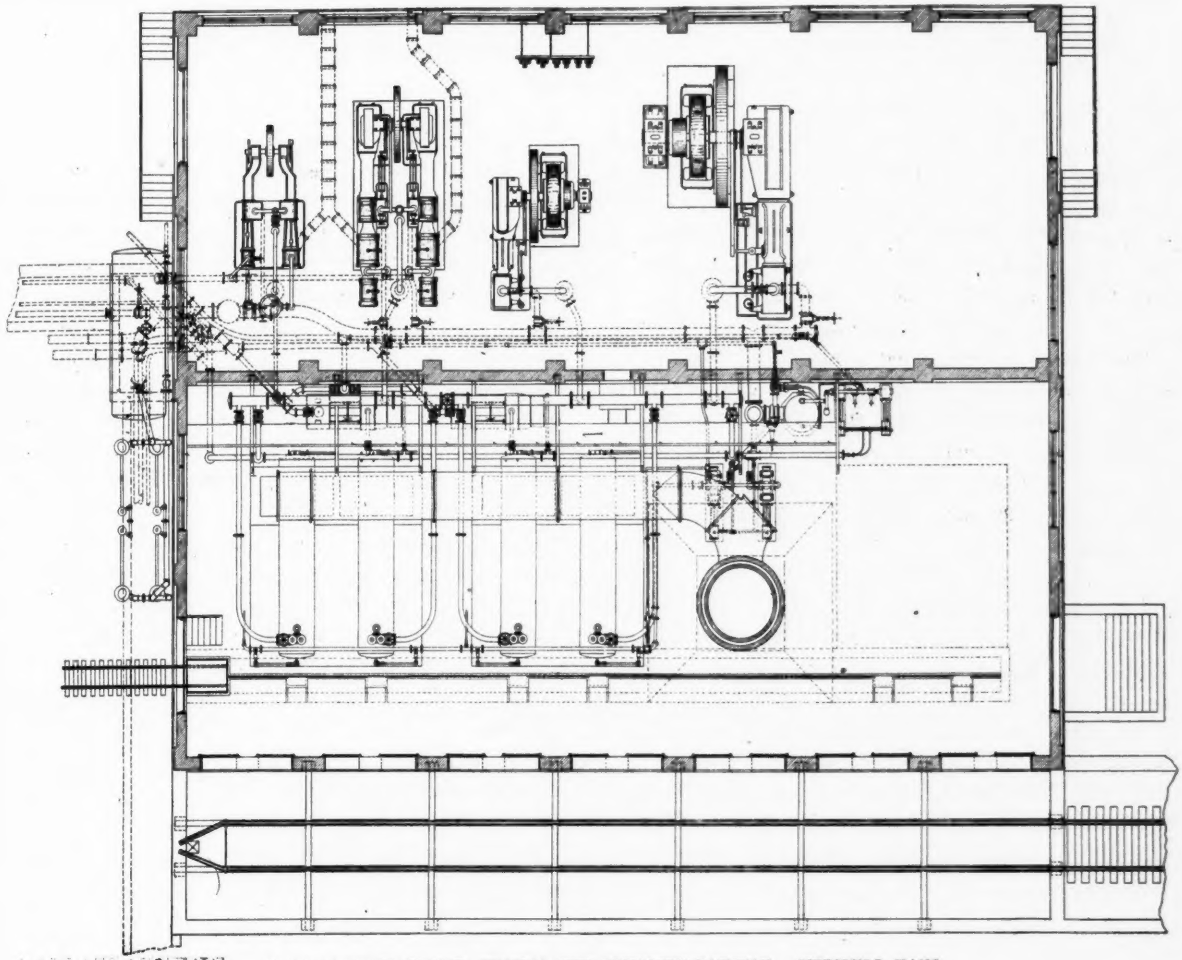
The blacksmith shop is adjacent to the boiler and tank shop. The interior of the shop is 120 feet by 90 feet. This is one of the old shops of the original plant, but it has been improved and enlarged 100 per cent by removal of the boiler shop from this section of the building.

COACH AND PAINT SHOP.

The coach and paint shop is another of the old buildings of the original layout and no change in the building structure was made here. The building is 144 feet 2 inches long by 107 feet wide, covering six transverse working tracks arranged on 21-foot centers, approached by a ladder system of yard tracks. Each track has a standing capacity of two coaches of small size. Varnish room, cleaning room, drying room, etc., occupy compartments at one end of the shop.

STOREHOUSE.

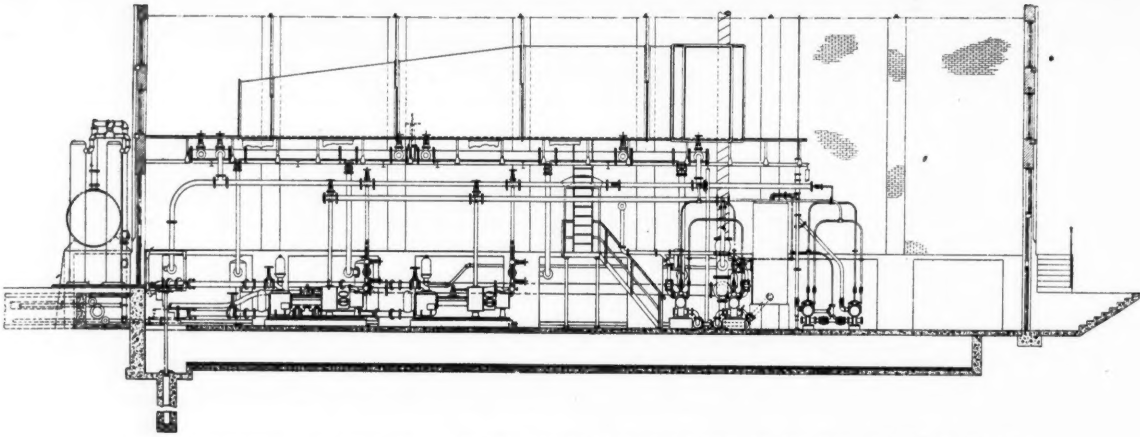
The storehouse is one of the original buildings. It is situated almost at the extreme end of the midway, on the north side, and one end platform is served by the yard crane. In addition to the office of the stores department, this building houses the offices of the superintendent of machinery and his entire force, including the drafting room. The building is 173 feet long by 55 feet wide, of one story, entirely surrounded by storage, loading and unloading platforms.



PLAN OF POWER HOUSE—KANSAS CITY SOUTHERN RAILWAY, PITTSBURG, KANS.

PLANING MILL.

The planing mill is adjacent to the crane served portion of the midway with which it is connected by a standard gauge material track. The section of the mill



PARTIAL LONGITUDINAL SECTION OF POWER HOUSE—KANSAS CITY SOUTHERN RAILWAY, PITTSBURG, KANS.

nearer the midway is separated from the remainder of the building by a wall and is occupied by a locomotive carpenter shop. The building occupied by these two shops is 202 feet 8 inches long by 68 feet wide. This building and the freight car repair shed are portions of the original plant, but the mill has been considerably enlarged at the sacrifice of some of the car repair space.

FREIGHT CAR REPAIR SHED.

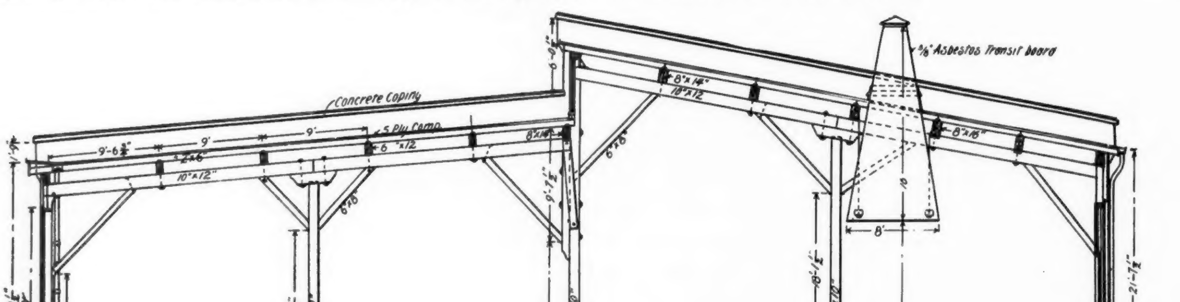
The freight car repair shed is next to the planing mill, with a common wall between the two, and is tributary to the midway. The shed is 202 feet 8 inches long by 48 feet wide, covering two longitudinal tracks, spaced on 24-foot centers. These tracks are continuations of yard repair tracks and extend into the yard served by the crane.

POWER HOUSE.

The power plant occupies a position at the center of the layout and is but a short distance from the planing mill. It is housed in a brick and reinforced concrete building with steel roof trusses carried by the walls. The foundation is of concrete. The building is 101 feet 6 inches by 98 feet 7 inches, divided longitudinally by a brick wall 13 inches thick, into two sections for the boiler room and engine room respectively. The separating wall extends from the foundation to the roof of the monitor traversing the full length of the building. The floor of the boiler room is 4 feet below grade and the floor of the engine room is 4 feet above grade. The floors are of reinforced concrete. The interior of the boiler room is 39 feet 11 inches wide and the clear height from floor to roof truss is 38 feet. The interior of the engine room is 37 feet wide and the clear height is 25 feet.

The engine room is served by a traveling crane of 24,000 lbs. capacity operated by hand from the floor, having a span of 35 feet 4 inches. The crane runway girders are 15-inch I beams carried on 12-inch pilasters corbeled to 18 inches at the top and capped with concrete. The top of the runway girders is 19 feet 6 inches above the floor.

Coal is carried in a reinforced concrete pocket just outside of the boiler room to which access is had by openings through the intervening wall. The bin has hoppered floor. One wall slopes from a point 16 feet from the wall of the boiler room to a point 6 feet 8 inches from the wall, so that coal will fall by gravity toward the boiler room floor. Above the coal pocket is a standard gauge track supported on steel beams to which coal cars are delivered. The coal pocket and delivery track are covered by steel canopy roof immediately adjacent to the wall of the boiler room.

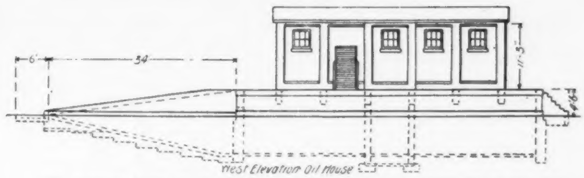


CROSS SECTION OF ROUNDHOUSE—KANSAS CITY SOUTHERN RAILWAY, PITTSBURG, KANS.

The boilers are operated with natural draft produced by a chimney 175 feet high and 7 feet 6 inches in diameter. The chimney is built of reinforced concrete of the Weber design. The location of the chimney is such that it will occupy a central position when the power plant shall have been increased to the capacity of the building or 100 per cent.

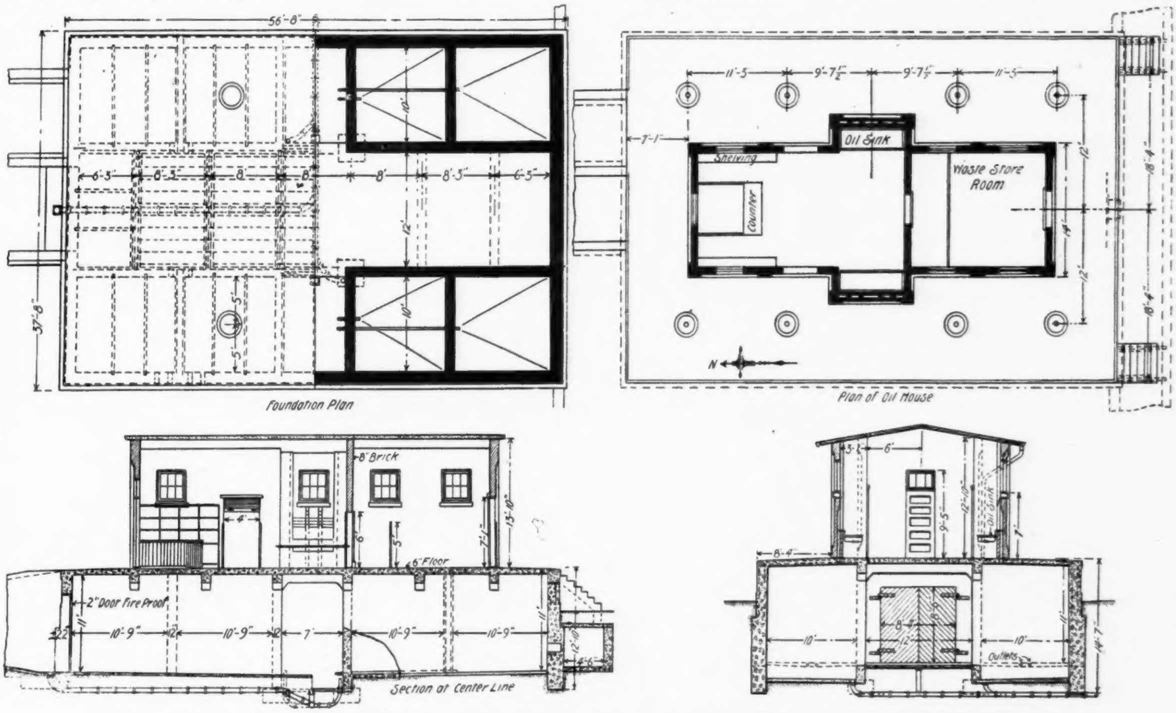
The boiler equipment includes two batteries, each with two Heine water tube boilers of 250 h. p. each, fired by hand. The grates are of the Dorrence type made by the Chicago Rocking Grate Co.

Boiler feed water is heated by a Colles 1,200 h. p. feed water heater and delivered to the boilers by two 10-6½-12 "American" boiler feed pumps. Condensation water from steam piping is returned directly to the boilers by a special system. Condensation water from



OIL HOUSE AND PLATFORM—KANSAS CITY SOUTHERN RAILWAY, PITTSBURG, KANS

type, operating at 115 and 230 volts. They were furnished by the Western Electric Company and we believe are the first machines of this kind made by the above company. The switchboard is of Monson slate made by Kohler Brothers. The 1,500 cubic foot air compressor was furnished by the J. Geo. Leyner Manufacturing Company and is of rather an unusual type being provided with duplex steam cylinders and duplex



PLANS, SECTION AND ELEVATION OF OIL HOUSE—KANSAS CITY SOUTHERN RAILWAY, PITTSBURG, KANS.

the heating system is returned to the feed water heater by two Marsh vacuum pumps. The general water service is maintained by two Platt Iron Works 750-gallon Compound Underwriter fire pumps arranged with switch valve for connecting high pressure steam to both cylinders, when pumps are used for fire service with 100 pounds pressure.

The engine room equipment consists of the following:

One 300 kw. direct connected generating unit.

One 150 kw. direct connected generating unit.

One 1,500 cubic foot air compressor.

One 750 cubic foot air compressor.

The engine for the 300 kw. unit is of the Corlis heavy duty type operating at 100 r. p. m. while the 150 kw. engine is of the 4-valve type operating at 150 r. p. m. Both engines were furnished by the H. N. Strait Company. The generators are of the 3-wire direct current

two-stage air cylinders, thus being practically two complete two-stage air compressors connected together. The 750 cubic foot compressor was in the original plant and removed to the new building and is of the Chicago Pneumatic Tool Company make.

ROUNDHOUSE.

The roundhouse occupies a position convenient of access from the machine and erecting shop and being near the midway, communication with the other departments is easy. By being situated at one side of the property the terminal tracks and auxiliaries serving the roundhouse offer no impediment to the operation of the shop plant.

The roundhouse is constructed with wood framing and brick end walls on concrete foundations. The outer wall is of reinforced concrete, sill high, and above this height the structure is of wood with large windows. The

columns on the inner circle are of cast iron with wooden swinging doors, reinforced with steel.

The construction of the roof provides for its main portion to slope gradually upward from the outer wall to a point just back of the cab of the average locomotive when standing with its stack under the smoke jack and headed away from the turntable. The roof over the inner portion of the house in which the tanks stand is lower than the main portion and slopes towards the doors. The vertical portion of the structure between the two sections of the roof is equipped with swinging glass sash and ventilators, thus admitting light at a point above the cab and adding to the means of ventilation.

The span of the roundhouse is 92 feet 3 inches with 98 feet 6¾ inches from inner wall to center of turntable. The table is 80 feet long, furnished by the Strobel Steel Construction Co., operated by an electric tractor furnished by Geo. P. Mehoes & Bro.

Smoke jacks are of ⅜-inch Johns-Manville asbestos transite board, having a flare of 8 feet by 3 feet at the bottom and tapering to 2 feet by 3 feet at the top.

The heating system is of the hot blast type with a slight variation from the usual manner of leading ducts from the main heating duct to the pits. Each lead duct is connected with two openings in the wall of one pit and with one opening in the wall of the next pit, so that hot air enters both sides of each pit.

The pits are 60 feet long by 3 feet 11 inches wide, with side and end walls of concrete. They are 2 feet 8 inches deep at the outer circle and 3 feet 2 inches in depth at end toward turntable. Bottoms are of paving brick on edge resting on a bed of sand. A small cesspool at the end of each pit, covered by cast iron grating, is piped to the general sewer system.

The roundhouse floor is covered with a coating of cinders 8 inches thick, well tamped.

Drainage of the roof sloping toward the inner circle is provided for by a gutter extending the full length of the roof. Outside of the gutter is a crown sloping toward the gutter to provide against any water falling in front of the doors which would freeze in winter. The gutter is drained by 4-inch cast iron pipes leading down inside the house to the cesspools of the pits. This arrangement is clearly shown by the sectional drawing of the roundhouse. The house is piped throughout for water, air, steam, and a blow-off main is provided with connections for each pit. A portable injector is used with the steam and water connections.

The arrangement of terminal facilities provides for the rapid movement of locomotives turned at the roundhouse without unnecessary switching or delay. There are two inbound and two outbound tracks. On one inbound track is an inspection pit with cinder pit adjoining and a second cinder pit nearer the turntable. At each cinder pit is a water column and a sand column serving both an inbound and an outbound track.

The sand columns represent a novel and unique arrangement which is at the same time quite simple. Wet sand is stored and dried in the usual manner, but instead of delivering dry sand to a bin elevated immediately above the sand house, it is delivered to two tanks elevated 24 feet 6 inches above the rail and conveniently situated at the cinder pits. Each tank is carried on a column built up of two 10-inch channels laced together with angle bars, and supported on a concrete base. One column is about 150 feet from the point of supply and the other is about 115 feet. Sand is delivered by air through pipes 3 inches in diameter.

A coal storage space 150 feet long by 24 feet 10 inches wide, having a capacity of 400 tons, is situated east of the cinder pit and inspection pit. This is traversed by a trestle to facilitate the delivery of coal in dump cars. Coal is delivered to locomotive tenders by a locomotive crane operating over the track between the cinder pit and the coal storage. The cinder pit is cleaned by the same crane transferring cinders and ash from the pit to suitable cars.

Three cross-over tracks connect an inbound and outbound track in order to facilitate movement around one or both cinder pits in case of a blockade.

An engine entering the terminal is spotted over the inspection pit where inspection is made immediately upon arrival. The report is made to the roundhouse at once in order that any necessary preparations may be made or required parts ordered before the engine enters the house. Over either cinder pit an engine may be spotted to take sand and water at the same time, while the fire is being knocked. Following the principle that a roundhouse is a repair shop and not a storage shed, ample provision is made for standing locomotives ready for dispatching on outside storage tracks in order that roundhouse pits may be reserved for boiler washing and for repairs that are absolutely necessary.

OIL HOUSE.

The oil house is one of the new buildings of the plant and includes a number of novel and interesting features. It provides for the storage and distribution of oils and waste for the terminal at which it is situated only. Its location as a portion of the general layout is near the roundhouse and at the same time easy of access from the machine and erecting shop, in order to provide for delivery of supplies to locomotives entering the roundhouse and for the distribution of such oil as is required in the machine shop.

The oil house includes a basement in which the storage tanks are located and a single story above for the storage of waste and for the distribution of supplies. The basement is built entirely of reinforced concrete and is 58 feet 8 inches long by 37 feet 8 inches wide and as the upper portion of the house is but 41 feet 6 inches long by 14 feet wide, the roof of the basement forms a platform around the storehouse. The surface of the platform is 4 feet above grade and the floor of the basement is 7 feet below grade. A double incline paved with brick provides a convenient means of traffic between the basement and the platform.

The walls of the oil house above the basement are of brick and the roof is made of 4½-inch cinder concrete reinforced with No. 10 expanded metal and supported on trusses of 45-pound old rail.

The oil tanks are of novel design, being built of reinforced concrete and the basement walls form a portion of the walls of the tank. The tanks are nearly square; they are lined with No. 9 sheet zinc and the floor of each tank slopes toward the outlet. The interior dimensions of each tank are 10 feet 9 inches by 10 feet by 10 feet 6 inches in depth. There are eight tanks so arranged along the outer walls as to leave a longitudinal space in the basement 12 feet wide and a transverse space 8 feet wide, between the pairs of tanks, to be used for the storage of barrels of oil. In the platform above each tank is a manhole 16¾ inches in diameter. Each n..nhole is covered with a cast iron cap fitting a cast iron lining.

The upper portion of the house is divided into two sections by a fire wall, one section for general distribution of supplies carried and one for the storage of waste. The waste room is still further subdivided by a woven wire partition 4 feet 6 inches from the intermediate wall, providing separate compartment for loose waste convenient to attendant.

Oil is delivered from the storage tanks by a system of auxiliary steel tanks to faucets in the delivery room by compressed air. Pipes from the several tanks lead to two sets of faucets, one set on each side of the delivery room, arranged in a recess in the wall so that they will not extend out into the room. Beneath each set of faucets is an oil sink to provide against waste and to collect drippings. The delivery counter is at the end of the delivery room opposite to the door of the waste room. All openings are equipped with steel rolling shutters and doors.

Construction on the Western Pacific Railway

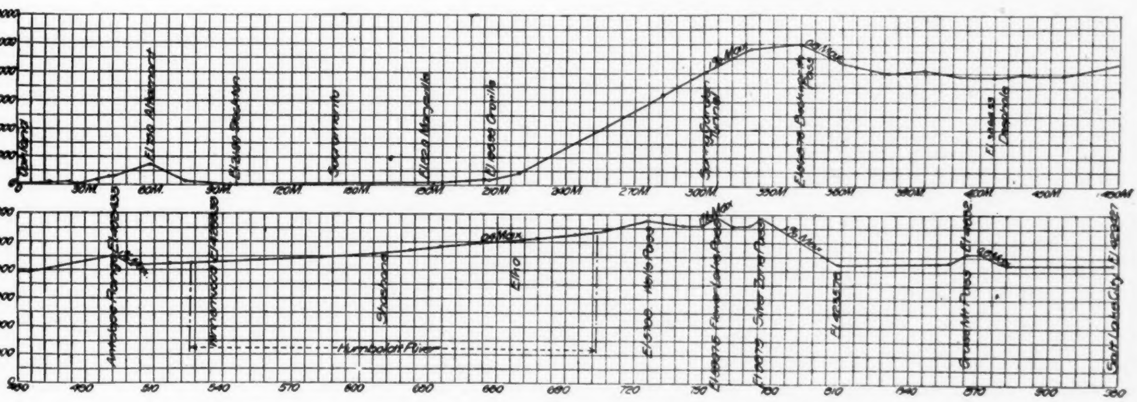
THE Western Pacific line, extending from Oakland, California, across the Sierra Nevada mountains to Salt Lake City, Utah, is a good example of the present practice in railroad construction. The maximum grade on the entire line is only 1 per cent and the maximum curvature is 8 degrees. It should be noted that the Sierras are crossed on the above grade and at an elevation of about 5,000 feet above sea-level, the summit being at Beckwith Pass. It is said that there will not be a snow shed anywhere on the road.

Another feature of the road is the tunnel construction. There are 47 tunnels, aggregating 45,450 feet in length, and the largest four are 7,294, 5,989, 5,560 and 4,287 feet in length.

The road from Chilkoot tunnel to Oroville is through an almost inaccessible region. The Nevada-California state line is crossed at an elevation of 4,360 feet and the approach to Beckwith Pass, 5,018.76 feet above sea-level, is on a grade of 0.8 per cent. About 20 miles west of the latter point, there is a 1 per cent descending grade to Oroville which is 198.95 feet above sea-level.

About a mile west of Spring Garden tunnel is located Williams Loop, which has a maximum diameter of 1,600 feet and a length of about 5,600 feet. The difference in elevation between the two tracks where they cross is 33 feet. The maximum curvature on the loop is 8 degrees and the minimum is 5 degrees.

The tunnels through the Sierra Nevadas are for single track construction, being 16 and 17 feet in width. The 16-foot section is used on tangents and curves of 3 de-



PROFILE OF LINE FROM OAKLAND TO SALT LAKE CITY, WESTERN PICIFIC RAILWAY.

grees or less and the 17-foot section on curves of over 3 degrees. The cross-section of the tunnel has an area of about 370 sq. ft., requiring an excavation of about 13.7 cu. ft. per lineal foot of tunnel. The distance from base of rail to roof of tunnel is 21 ft. 3 ins. All timber is of Oregon pine, the main timber being 12x12 ins. and the lagging 4x12 ins.

It is not expected that the road can be completed before September, 1908. The work is in charge of Mr. V. G. Bogue, vice-president and chief engineer.

Proposed Rail Sections

THE rail sections, here illustrated, have been recommended by the committee of the American Railway Association on "Standard Rail and Wheel Sections." These new designs were submitted for the consideration of the members and will probably be discussed and acted upon at the April meeting of the association. The illustrations cover the two types of 80, 90 and 100 pound rails.

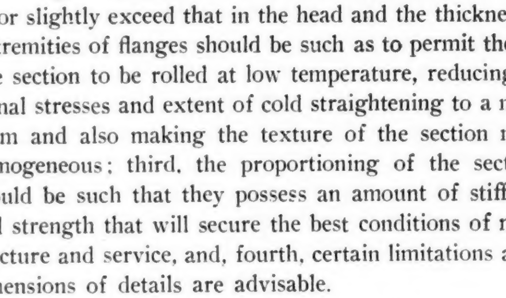
The principles involved in the design were agreed upon by the sub-committee. These principles are outlined as follows: First, the distribution of metal between head and base should be such as to insure the best control of temperature in the manufacture of the rail; second, the percentage of metal in the base should preferably be equal to or slightly exceed that in the head and the thickness at extremities of flanges should be such as to permit the entire section to be rolled at low temperature, reducing internal stresses and extent of cold straightening to a minimum and also making the texture of the section more homogeneous; third, the proportioning of the sections should be such that they possess an amount of stiffness and strength that will secure the best conditions of manufacture and service, and, fourth, certain limitations as to dimensions of details are advisable.

The limitations of the dimensions of details are as follows:

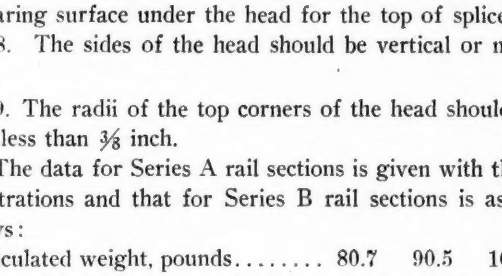
1. The width of base to be ½ inch less than the height.
2. The fishing angles to be not less than 13 degrees and not greater than 15 degrees.
3. The thickness of the base to be greater than with existing sections of corresponding weight.
4. The thickness of the web to be no less than in existing A. S. C. E. sections of corresponding weight.
5. A fixed percentage of distribution of metal in head, web and base for the entire series of sections need not be adhered to, but each section in a series can be considered by itself.
6. The radii of the under corner of the head and top and bottom corners of the base to be as small as practicable with the colder conditions of rolling.
7. The radii of the fillets connecting the web with head and base to be as great as possible for reinforcement purposes, consistent with securing the necessary area for bearing surface under the head for the top of splice bar.
8. The sides of the head should be vertical or nearly so.
9. The radii of the top corners of the head should not be less than ⅜ inch.

The data for Series A rail sections is given with the illustrations and that for Series B rail sections is as follows:

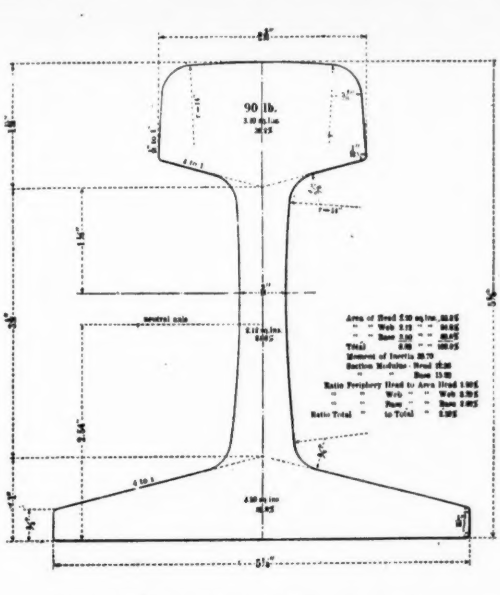
Calculated weight, pounds........	80.7	90.5	100.5
Area of head, square inches.....	3.07	3.56	3.95
Per cent of total................	38.8	40.1	40.2



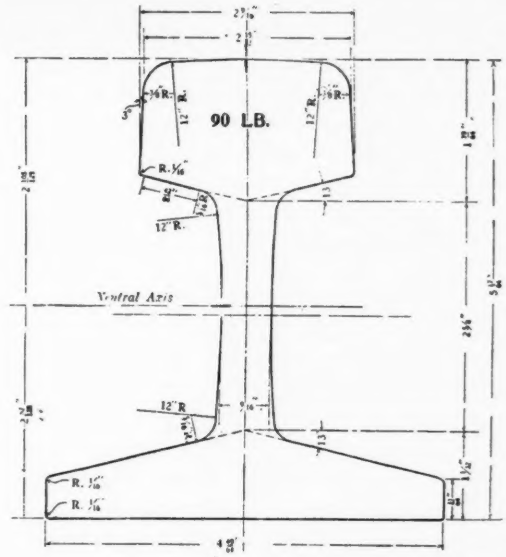
PROPOSED 80-POUND RAIL SECTION—SERIES A.



PROPOSED 80-POUND RAIL SECTION—SERIES B.



PROPOSED 90-POUND RAIL SECTION—SERIES A.

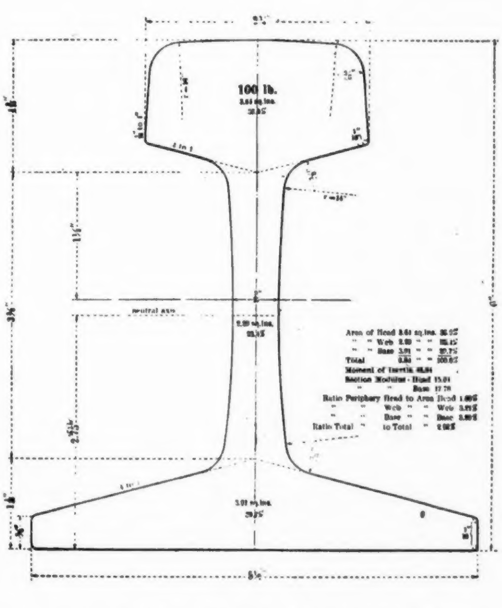


PROPOSED 90-POUND RAIL SECTION—SERIES B.

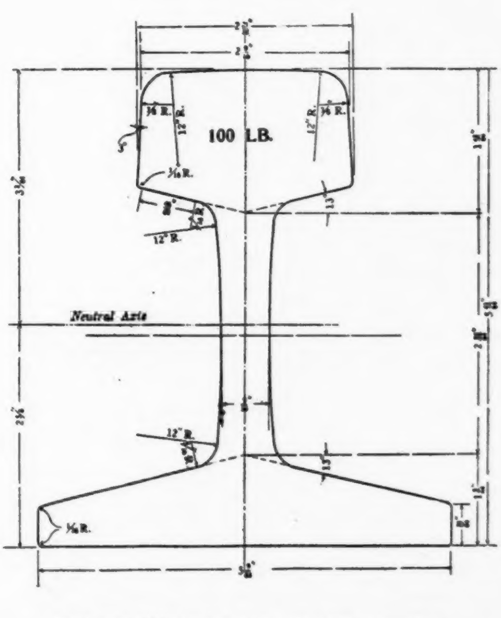
Area of web, square inches......	1.54	1.70	1.89
Per cent of total	19.5	19.2	19.2
Area of base, square inches......	3.30	3.61	4.01
Per cent of total	41.7	40.7	40.6
Total area, square inches........	7.91	8.87	9.85
Moment of inertia.............	25.1	32.3	41.3
Section modulus, head	9.38	11.45	13.70
Section modulus, base...........	11.08	13.21	15.74
Ratio periphery to area, head....	1.79	1.68	1.64
Ratio periphery to area, web.....	3.57	3.65	3.60
Ratio periphery to area, base.....	2.72	2.58	2.49
Ratio periphery to area, total.....	2.53	2.42	2.37

Each series included designs for 60 and 70 pound rails. The sections provide for a larger proportion of metal in the base than in the head. The Series A sections have greater moments of inertia than those of Series B and are also stiffer. In the design of the former the girder function of the rail and its ability to distribute the load over a number of supports was emphasized.

The Pennsylvania Railroad Company announces that it will continue the policy inaugurated some time ago of furnishing to the public prompt and accurate information of interest relative to its affairs, and that Mr. Ivy L. Lee, who retires from the firm of Parker & Lee (who have hitherto acted for the company in this capacity) will on January 1, 1908, enter the service of the company, and have particular charge of this work.



PROPOSED 100-POUND RAIL SECTION—SERIES A.



PROPOSED 100-POUND RAIL SECTION—SERIES B.

Manufacture of Steel Rails

At a recent meeting of the Central Railway Club at Buffalo, N. Y., a paper was presented by Mr. Franklin E. Abbott, on the subject of "Steel Rails." An abstract of this paper is here given, being almost entirely a discussion of steel rails from the utilitarian point of view. The description was limited to the Bessemer steel process of rail manufacture and the references to rolling mills were to the mills of the Lackawanna Steel Company.

The process of mining Messebe ores, from which statistics show two-thirds of all rail steel is made, is very simple. The ore beds are only a shallow depth below the surface, the maximum now not exceeding 50 or 60 ft. The earth, covering the ore, is stripped from the ore beds by the ordinary methods used in railroad construction. After the ore is uncovered the process of mining is carried on by steam shovels after the method of excavating a gravel pit. One plan is to start a long trench and, as the depth increases, lay switchback tracks so that a workable grade may be maintained. Another is to excavate the mine circularly, working in a circle from ¼ to ½ mile in diameter. Steam shovels are worked inside of a circular pit and ore cars are operated over tracks laid in form of spiral to the most practicable curves and grades.

The ore dump cars carry the raw material to the docks at Duluth and Superior, where they are weighed before the ore is dumped into large pockets. The ore is loaded into the vessels almost entirely through chutes and at its destination is unloaded by clam shell buckets. There is very little hand-work required in the removal of the ore from its native bed to the furnace.

The ore is charged into the furnaces with the proper proportion of coke and limestone and the pig iron is tapped out at the base. Steel is made by a direct process, which consists in taking molten iron direct from the blast furnaces to the steel plant and continuing the process of making steel without allowing the iron to become solidified. The iron is carried from the furnaces in ladles, which hold about 20 tons, and poured in a large mixer of about 200 tons capacity in order to make a better average composition of iron and produce a more uniform grade of steel.

The iron is drawn from the mixer into ladles of 10-ton capacity and charged into the converter, where the iron is changed into Bessemer steel. The steel is then poured into a ladle and from the ladle it is tapped into ingot molds where it is left to solidify. The ingot molds, which are set upright on heavy cast iron table cars, are moved under the stripper, which consists of a crane equipped with a combination of lifters and plunger. The ingots are forced through the bottom of the molds and left standing upright on the car.

When the molten metal comes in contact with the mold it hardens immediately at the sides and base and gradually toward the center. The contraction of the metal causes the mass to draw in at the top, the cavity extending a few inches down. This action is termed piping. Segregation of the constituent elements, such as carbon, sulphur and phosphorus, also develops in the process of cooling. On account of this latter difficulty the steel has an excess of the elements above named at the top of the ingot where the metal is last to cool. The steel is inferior at the top of the ingot and this section of the ingot is discarded.

After the ingots are stripped, they are forwarded on the same iron cars to the rail mill, deposited in reheating furnaces, called soaking pits, and left there until brought to the proper temperature for rolling. The ingots are placed in a vertical position in the soaking pits, where they remain for 90 to 150 mniutes. The heat treatment brings the ingot to a more uniform temperature and to an approximately plastic condition for the rolling mills. The ingots are conveyed quickly to the blooming rolls where two passes are first made causing a heavy reduction. In the next set of rolls four passes are made and a bloom about 8x8 inches, 20 to 22 feet in length, is formed. Sufficient metal is then cut off one end to remove all traces of the inferior steel and off the other end to make the face square and solid. After the shearing, the bloom is conveyed to the roughing rolls where a rough form of rail section is worked out in four passes. The bar then goes to the finishing rolls, making four more passes, and finally is given a last finishing pass, when the rail section is practically completed. The block of steel, about 18 inches square and 50 inches long, was changed into a rail with a sectional area of 6 to 7 square inches and 175 feet in length. The operation requires 8 or 9 minutes.

The long rail is then taken to the hot saw and the required lengths are cut one at a time, thence through the cambering rolls to the cooling beds. In the cambering rolls the rails are given a curvature with the head arching upwardly in order that the rails will cool as nearly straight as practicable. The rails are passed from the cooling beds to the presses where they are straightened, drilled, finished and inspected.
spected.

There are 9 or 10 classifications of rail failures, but more than 95 per cent can be placed under less than half that number. The head failures are the result of piping, or of the metal shearing off at the sides, usually about on line with one side of the web. The piping is a defect inherent in the steel and the responsibility for this rests with the manufacturing. While every precaution is exercised against defective material, some creeps into use now and then because piping in ingots is not always confined to the top, occurring sometimes all the way down through the center. Such piping does not give any indication at the ends or on the surface when the rails are finished, but usually develops under traffic, the head flattening or spreading out. Only a

small percentage of piped rails give out suddenly without first showing this condition on the head surface, and thus affording time for their removal.

Split head failures occur mainly on high curvature track and on the inside or low rail of the curves. Irregular bearings of worn wheels and cross strains by tread of false flanges on extreme outside corner are causes. Such breaks are generally found about on line with side of web, this leverage bringing the maximum stress at top of rail heads.

Failure also results from the flow of metal or the crushing off at the corners of the head. The metal is caused to flow or shell off in long, ragged strips when the inside wheel of a train passes around a curve and not only rolls, but also slips over the rail and, too, if the gauge is wide, slides across the head. While such rails present a bad appearance and ordinarily show excessive wear, they are not unsafe and may be retained in service until completely worn out.

Complete fracture of the entire section is more often the cause of failure and is the most dangerous. These breaks are of three distinctive characters. The first is the square break, the fracture being almost at a right angle with the axis of the rail and often quite as regular as a saw cut. The fractured surface may be fine, close and homogeneous in texture, but the shape of the break indicates excessive hardening properties in the metal which bring it close to the point of brittleness and allow it to be easily ruptured by shock. The second is the angular, or shearing, break which passes through the section at an angle with the longitudina l axis. This shows that the rail elongated before breaking and indicates ductility and a good grade of steel. The third is the base break which covers a large percentage of the failures. This break starts at the center of the rail base, develops longitudinally from 6 to 18 inches and then runs out to the edge of the flange, resulting in a half-moon or flange break. In some cases it extends upward through the rail, causing fracture of the entire section.

The T-rail should be considered chiefly, or almost entirely, as a girder reaching across short spans supported at the ends and loaded at the center. The base is properly shaped to sustain tensile strain and rests on foundations placed every few inches along its length and, as the spans are short, enormous loads may be carried by the average sized rail. The rail foundation, however, is unstable and yielding and the whole bearing surface of the rail is quite irregular and uneven. In consequence thereof the base is subject to excessive compressive strains and in compression the rail base will buckle. The rails that fail, constitute, however, only a fraction of 1 per cent of the total tonnage.

For a new design of rail section to withstand the heavy loads and fast traffic of today, it is suggested that the head and base be reinforced, that the distribution of metal be nearly balanced and that the width of base be less than the height of rail. The advantages of a balanced section with comparatively thick base are as follows: First, lower temperature of the whole section at the final pass, a colder finish of the rail head, giving better and denser wearing material; second, less cambering and better hot straightening, reducing, as much as possible, the objectionable cold straightening work; third, a reinforced head to provide against splits and other head failures, and, fourth, a reinforced base to overcome the weakness that seems so prominent in present pattern rails.

Progress on New Panama Railroad

WORK on the new location of the Panama railroad is advancing steadily. The new location leaves the old line near Mindi, and the grading between that point and Gatun is practically finished.

One of the largest railroad embankments in the world, and probably the largest in point of average height to length, is located at Gatun on the new line of the Panama railroad. It crosses the valley of the Gatuncillo river at an average height of about eighty-two feet, is 1¼ miles long, and contains over 2,600,000 cubic yards of material. Owing to the great height and length of this fill it will be necessary to build it in three sections. A trestle, thirty feet high and running the entire length of the fill, will first be built, from which material will be dumped by the construction trains. When the dirt reaches the top of the trestle another 30-foot trestle will be built on the dump thus formed, and the operation will be repeated until the final grade of the railroad is reached. The fill crosses an arm of the lake that will be formed by the Gatun dam and an opening will be left at the bottom of the fill in case it ever becomes necessary to drain the lake. In order to allow passage for boats a drawbridge of the Bascule type, about 100 feet long, is being considered.

The new bridge over the Chagres river near Gamboa will be 1,320 feet long, consisting of fourteen 80-foot through-girder spans and one 200-foot through-truss span. The contract for the steel work has been let to the Penn Bridge Company and delivery will begin next March. The fifteen spans will rest on fourteen piers and two abutments, all of which will be built of concrete on pile foundations. The south abutment and the two south piers are completed and the pile foundation driven for a third pier. It is estimated that the masonry work will be nnished about July, 1908.

There will be a tunnel at Miraflores, the first on the Isthmus, about 600 feet long. The north approach to it is practically completed and 75 feet of heading has been driven. The south approach is also completed and the heading has been started. It will be a single track tunnel and will be lined its entire length with concrete. The above information was obtained from the Canal Record.

The firm of Parker & Lee, heretofore engaged in the work of publicity at 20 Broad street, New York, was dissolved on December 31, 1907, by the retirement of Mr. Ivy L. Lee. The business will be continued at the same address, George F. Parker for this purpose having associated with himself Charles A. Bridge, hitherto manager, under the firm name and title of Parker & Bridge.

Technical Training

AT the December meeting of the Western Railway Club a paper on the subject of technical education was presented by Mr. Richard T. Crane, Sr., president of the Crane Company. The paper urged the futility of technical education, maintaining that college education seems almost fatal to success in the business domain as technical graduates will be distanced by clerks and mechanics.

On the second day after the presentation of this paper, the following editorial appeared in the columns of the Chicago Daily Tribune:

Large amounts of money have been given by practical men of affairs to establish and endow technical schools. The fact that, having been denied the advantages of training in the schools, they desire to give better opportunities to people of another generation is a pretty good reason for the existence of such institutions. It probably is true that the greater part of the millions given to higher education of whatever sort has come from the bounty of men who made their wealth without having had the advantages of the training which they seek to give to those who are to follow them. It is unreasonable to suppose that large endowments would be given in this way if the self-made donors did not realize their own loss because of the lack of educational opportunities.

Another fact is equally apparent. The technical schools cannot turn out well equipped men fast enough to meet the constant demand for their services. Any professor of standing will bear testimony that the requests made for trained men in his department exceed the available supply. In many of the technical schools the members of the graduating classes are placed before they receive their diplomas, leaving the institution on commencement day to begin work in good positions. In some lines no one but such a graduate can secure a place. Such a condition of things is eloquent of the worth of technical training.

If a thousand men whose training was limited to a grammar school course and practical experience in the shop were selected and put side by side with another thousand from Rensselaer, Massachusetts Institute, the Sibley School, Purdue, Stevens Institute, Worcester Polytechnic, and similar technical schools the chances are many that the latter group would furnish the larger number of efficient and successful workers. If the attainments of the entire body of graduates of American technical schools were compared with those of an equal number of workers without any advantages of the schools the result would not be doubtful.

The captains of industry are relatively few. Their success often has been due to native genius. Sometimes peculiar conditions have helped them forward. Leadership in other fields has come in the same way. Those who have been trained for command often have failed completely. But where one man has gone from the grammar school and the four years' observation in the shop to the head of a great establishment there have been thousands who have trudged their way through life with little enjoyment of its opportunities, with relatively small influence upon their fellows, and with a horizon limited by the walls of the factory.

Hundreds of educated men have wasted their chances. Hundreds have failed completely in a chosen profession. Leadership among them may have been less frequent than it should have been. But the great majority of those who crowd the technical schools to overflowing are there because of the encouragement of employers or friends who tell them of the better opportunities open to those who are educated. It is not by the relatively few captains of industry that the technical schools are to be judged. Nor are the many failures to be charged against them without frank recognition of the percentage of failures everywhere. It is in raising the average of intelligence that their greatest value lies.

The Waning Hardwood Supply

THE following extract of Circular 116 of the Forest Service, U. S. Department of Agriculture, relates to the solution of the hardwood supply:

If it is true that the hardwood supply is approaching a condition of shortage which would paralyze many of the greatest industries and gravely affect the entire country, then it is important to seek diligently the best means to avert it, or if that is not wholly possible, to reduce its injuries to the minimum.

The belief is common that the substitution of softwood, metal, and concrete for hardwood will gradually take place as the supply of the latter is reduced. Already the substitution of metal has made much progress. It has replaced hardwood to a considerable extent in the manufacture of implements, furniture and cars, and even in the interior finish of office buildings and in general construction work. Concrete has also come into wide use in construction. Yet, prominent as these materials have become, they seem not to have reduced the demand for hardwood, which, besides being retained for the greater number of its original uses, has also found new ones. There is not now much tendency for softwoods to replace hardwoods, and there is not likely to be, because they have not the strength or other properties to make them acceptable as substitutes. The replacement of hardwood by other materials is to be welcomed where those materials make for better service and cheaper cost. Where they will not, and experience thus far shows this list to be a large one, the problem of a hardwood shortage must be solved in another way.

There seems to be but one practicable solution, and that is to maintain permanently under a proper system of forestry a sufficient area of hardwood land to produce by growth a large proportion of the hardwood timber which the nation requires.

Where is this land to be found? Not in the Ohio

valley, the Lake states, or the Mississippi valley, for the reasons already given. It is to be found in the Appalachian mountains. These mountains increased their proportion in the nation's hardwood output from 42 to 48 per cent during the past seven years. On the principle of using the land for its highest purpose they should further increase their proportion to not less than 75 per cent. Other sections of the country will readily furnish the remaining 25 per cent.

APPALACHIANS THE KEY TO THE SITUATION.

The mountain ranges from Maine to Alabama should be made to produce the greater part of the hardwood supply, because growing hardwood timber is their most profitable use. There is, in fact, no other use to which the surface of these mountains can permanently be put. That they can not be successfully farmed has been proved in thousands of cases. For the most part they can not even be permanently grazed.

It is in the production of timber that they excel. They bear the greatest variety of species and the best remaining hardwood growth anywhere to be found. Freed from their enemies—fire and unwise cutting—their forests readily reproduce the best kinds of timber. Outside of local areas of the Pacific coast nowhere else is forest growth so rapid. Even land cleared and farmed to the complete exhaustion of its soil will in this region in time reclothe itself with forests, if only it is protected.

Field estimates by counties show that south of Pennsylvania there are in the Appalachians 58 million acres of forest land, practically all of which is covered with hardwood and over 85 per cent of which is in a cut-over or culled condition. Including the mountains of Pennsylvania, New York and New England it is probably safe to estimate that the entire Appalachian area includes as much as 75 million acres primarily adapted for hardwood timber. Only a very small part of this is still in virgin growth. By far the great part of it has been cut over, and some of it has been cleared.

Well managed and protected from fire, this area has enormous producing powers. Studies by the Forest Service of average virgin and cut-over lands in eastern Tennessee show that under protection these lands are capable of producing 50 cubic feet of wood per acre annually. Even taking the production as 40 cubic feet, this means for the area of 75 million acres a possible annual production of 3 billion cubic feet.

How does this compare with the annual requirements? The 25 billion feet, board measure, used annually (allowing a product of 8 feet B. M. for each cubic foot, which is believed to be not too high under present utilization), represents a little over 3 billion cubic feet. This is just about equal to the amount which the Appalachian forest is capable of producing. When it is remembered that the Appalachians will probably not be called upon to furnish more than three-fourths of the total supply, it is clear that there is a good margin of safety. Therefore, if the Appalachian forests are rightly managed and taken soon enough, they will insure continuously the hardwood supply of the country, and do it without exhausting the forest. In fact, it can be done so that the systematic treatment will at the same time improve the forest.

Our experience will doubtless be the same in this respect as that of Germany. In Saxony the cut, which represents only the growth, increased during the period from 1820 to 1904 55 per cent, bringing the annual yield to 93 cubic feet per acre. Prussia shows a still more pronounced increase. In 1830 the cut was only 20 cubic feet per acre, and in 1865 had increased to only 24 cubic feet. But in 1890, owing to proper management, it had risen to 52, and in 1904 to 65 cubic feet. These results came largely from nonagricultural lands, sandy plains, swamps, and rough mountain slopes, and from forests which had been mismanaged, much the same as ours.

Much of the Appalachian forest has been so damaged that years will be required for it to reach again a high state of productiveness. Its present average production is probably not over 10 cubic feet per acre per year. The increase would, of course, be gradual and it would be slow at first. It would be some time before it could average the 40 cubic feet per acre used in the above estimate. Until it does we can expect a shortage in hardwood timber. The longer the delay in putting this forest under control, the longer continued and more extreme will be the shortage.

Bay Shore Cut-Off, Southern Pacific

ON the opening of the Bay Shore cut-off the Southern Pacific eliminated the disadvantages of the old Coast Line route and doubled the available industrial area of San Francisco. Trains were sent over the Southern Pacific's new line piercing the five ranges of hills which have heretofore formed a barrier against the expansion of the city southward. In traversing this 10 miles of road travelers pass through two miles of tunnels with the ground surface 300 feet above their heads, over two miles of trestle with the water 50 feet below them, through a cut 95 feet deep, and under six streets supported overhead by iron bridges.

Not only does San Francisco benefit immensely by these improvements, and the railroad vastly improve its facilities for handling traffic, but with the completion of the Cut-Off nineteen towns from San Francisco to San Jose have the advantage of a gain of seventeen minutes in time to and from the city. Nearly five miles, many curves and the heavy grades of the Coast line are saved by the Bay Shore improvement.

At Visitacion Point the Southern Pacific is constructing a hump yard that will enable the road to distribute much more efficiently the vast volume of freight handled here. In addition to the hump yard on 140 acres of ground, where once was Visitacion Bay, the company is providing complete facilities for receiving, classifying, shipping, and storing freight.

Prices on Track Material, F. O. B., Chicago

TRACK SUPPLIES.

Steel Rail, 60 lbs. and over.......$28.00 per gross ton
Steel Rail, 25 to 45 lbs........... 32.00 per gross ton
Steel Rail, 20 lbs. .... 33.00 per gross ton
Steel Rail, 16 lbs. .... 34.00 per gross ton
Steel Rail, 12 lbs. .... 35.00 per gross ton
Ties, 6x8x8 oak, 1st grade....................77c each
Ties, 6x8x8 oak, 2d grade....................67c each
Switch Ties ....$30.00 to $35.00 M. ft.

Angle bars, accompanying rail orders, 1907 delivery, 1.65c.; car lots, 1.75c. to 1.85c.; spikes, 2.00 to 2.10c., according to delivery; track bolts, 2.50c. to 2.60c., base, square nuts, and 2.65c. to 2.75c., base, hexagon nuts. The store prices on track supplies range from 0.15c. to 0.20c. above mill prices. Switch set per turn out, 60-lb. rail, $85 to $90.

OLD MATERIAL.

Old Steel Rails, rerolling ....$12.00 to $12.50
Old Steel Rails, less than 3 ft.......... 12.00 to 12.50
Old Iron Rails .... 15.00 to 15.50

SHEET STEEL.

It is quoted for future delivery:

Tank plate ¼-in. and heavier, wider than 6¼ and up to 100 in. wide, inclusive, car lots, Chicago, 1.88c. to 2.08c.; 3-16 in., 1.98c. to 2.18c.; Nos. 7 and 8 gauge, 2.03c. to 2.23c.; No. 9, 2.13c. to 2.33c. Flange quality, in widths up to 100 in., 1.98c. to 2.08c., base for ¼-in. and heavier, with the same advance for lighter weights; Sketch Plates, Tank quality, 1.98c. to 2.18c.; Flange quality, 2.08c. Store prices on Plates are as follows: Tank Plate, ¼-in. and heavier, up to 72 in. wide, 2.20c. to 2.30c.; from 72 to 96 in. wide, 2.30c. to 2.40c.; 3-16 in. up to 60 in. wide, 2.30c. to 2.40c.; 72 in. wide, 2.50c. to 2.65c.; No. 8 up to 60 in. wide, 2.35c. to 2.45c.; Flange and Head quality, 0.25c. extra.

STRUCTURAL STEEL SHAPES.

Store quotations are unchanged at 2.05c. to 2.10c., and mill prices are as follows: Beams and Channels, 3 to 15 in., inclusive, 1.88c.; Angles, 3 to 6 in., ¼-in. and heavier, 1.88c.; larger than 6 in. on one or both legs, 1.98c.; Beams, larger than 15 in., 1.98c.; Zees, 3 in. and over, 1.88c.; Tees, 3 in. and over, 1.93c., in addition to the usual extras for cutting to extra lengths, punching, coping, bending and other shop work.

CAST IRON PIPE.

Quotations per net ton on Water Pipe, 4 in., $34; 6 to 12 in., $33; over 16 in., $32; with $1 per ton extra for gas pipe.

CEMENT.

Good grade Portland Cement, car lots..$2.00 per bbl.*

* (Four sacks per bbl. credited 10c each when returned in good condition.)

SAND.

Bank sand, car lot ....$0.65 per yd.
Torpedo sand, car lot.................... 1.15 per yd.

CRUSHED STONE GRAVEL.

Crushed limestone, car lot................$1.05 per yd.
Crushed gravel, car lot.................... 1.00 per yd.

Personals

Mr. J. Y. Hill, trainmaster of the Northern Alabama at Sheffield, Ala., has bn appointed engineer maintenance of way of the Southern at Birmingham, Ala.

Mr. E. McGee, roadmaster of the Missouri Pacific at Hoisington, Kan., has been transferred to Pueblo, Colo., in a similar capacity, succeeding Mr. W. E. Tracy, resigned.

Mr. W. C. Koehler has been appointed roadmaster at Hoisington, Kan., in place of Mr. McGee.

Mr. C. L. Eaton has been appointed assistant division superintendent of the Denver & Rio Grande at Alamosa, Colo.

Mr. W. Jay Turner has tendered his resignation as president of the Lehigh Valley, to take effect on January 1, at which time he will be succeeded by Mr. W. A. Lathrop, president of the Lehigh Coal & Navigation Company. Mr. Turner will remain with the company as vice-president and general counsel.

Mr. H. S. Jones has resigned as chief engineer of the Mobile Jackson & Kansas City and the office has been abolished.

Mr. James Oborne, general superintendent of the Ontario division of the Canadian Pacific, has been appointed superintendent of the eastern division, with office at Montreal, Que., to succeed Mr. H. P. Timmerman, resigned. Mr. F. P. Brady, general superintendent of the Lake Superior division, has been transferred to Toronto, Ont., succeeding Mr. Oborne as superintendent of the Ontario division. Mr. C. Murphy, superintendent at London, Ont., has been appointed general superintendent of the Lake Superior division, with headquarters at North Bay, Ont., in place of Mr. Brady.

Mr. J. J. Lewis has been appointed superintendent of terminals of the Mexican Central at Tampico, Mex., to succeed Mr. R. N. Elliott, transferred. Mr. Lewis was formerly superintendent of terminals of the Tehuantepec National at Coatzacoalcos, Mex. Mr. W. T. East, assistant superintendent of terminals of the Mexican Central at Tampico, Mex., has been appointed trainmaster of the San Luis division.

Mr. J. E. Kelly has been appointed superintendent of the Orange & Northwestern, with headquarters at Orange, Tex., succeeding Mr. W. W. Yeatman, resigned.

Mr. E. H. O'Neil has been appointed assistant general superintendent of the Manistee & Northeastern, with office at Manistee, Mich.; effective on December 10.

Mr. A. Ramseur has resigned as division superintendent of the Southern at Asheville, N. C.

Mr. J. H. Fraser, superintendent of the Detroit Toledo & Ironton, has moved his headquarters from Springfield to Toledo, O.

Mr. S. P. Hull, engineer of signals of the New York Central & Hudson River, has been appointed engineer of maintenance of signals, with office at New York, N. Y., with jurisdiction over all divisions except the electric division. Mr. W. H. Elliott has been appointed to succeed Mr. Hull as engineer of signals, with headquarters at New York, having authority over all divisions except the electric.

The headquarters of Mr. H. B. Welsh, supervisor of the Pennsylvania Railroad at Corry, Pa., have been changed to Titusville, Pa.

Mr. E. L. Watson has been appointed supervisor of signals of the Philadelphia division of the Pennsylvania Railroad in place of Mr. W. M. Schnure, transferred.

Mr. Wayne A. Clark, assistant engineer of the Duluth & Iron Range, has been appointed chief engineer, with office at Duluth, Minn., succeeding Robert Angst, deceased.

Mr. C. Hightower, assistant division superintendent of the International & Great Northern at Palestine, Tex., has been appointed, division superintendent, at Mart, Tex., succeeding Mr. C. J. Larimer, resigned.

Mr. F. S. Forest, who on December 1 was appointed general superintendent of the Portland & Seattle, with headquarters at Portland, Ore., will have jurisdiction over the Astoria & Columbia River also.

Mr. James L. Truden, acting superintendent of the Albany division of the Boston & Albany, has been appointed superintendent of that division, with office at Springfield, Mass., succeeding Mr. Charles Firth, transferred.

Mr. S. M. Felton tendered his resignation as president of the Chicago & Alton to become president of the Mexican Central.

Mr. J. M. Johnson, assistant to the vice-president of the Gould Lines, has been elected vice-president in charge of freight and passenger traffic of the Missouri Pacific lines, with headquarters at St. Louis, Mo. Mr. E. B. Boyd, heretofore manager of transportation of the Chicago Board of Trade, succeeds Mr. Johnson as assistant to the vice-president of the Gould Lines, with office at Chicago.

Mr. F. W. Brown has been appointed trainmaster of the Southern at Atlanta, Ga., in place of Mr. G. A. Bradley, promoted.

Mr. J. B. Gallary has been appointed assistant superintendent of the western division of the New York, New Haven & Hartford at Providence, R. I.

Jacobs Improved Drill Chuck

The construction and outside appearance of the Jacobs improved drill chuck is shown in the accompanying illustrations. This chuck is another example of the axiom "necessity is the mother of invention."

Five or six years ago the inventor of the Jacobs chuck could not find a drill chuck that would do its work in a satisfactory manner. The two-jawed chucks on the market, although they had a convenient key locking device, were undesirable in shape, would not keep true, were slow to adjust, and lacked sufficient gripping power.

The three-jawed chuck was well shaped, well constructed, would keep remarkably true, a large range of adjustment could be easily and quickly made; but it lacked a convenient device for securely locking.

This type of three-jawed chuck is adjusted by revolving the sleeve upon the body of the chuck. To securely lock the chuck, it was necessary to use a spanner to force the sleeve to revolve. This action was inclined to revolve the whole chuck and the spindle as well. To offset this tendency, the operator grasped the belt with one hand—thus injuring the belt—while with the other he applied force to the spanner, which frequently twisted the chuck off the shank, or the shank out of the spindle. If all worked well, he would succeed in adjusting the chuck, but as both hands were occupied in the adjustment, the drill would often fall to the floor.

The inventor of the Jacobs chuck overcame these serious deficiencies by applying the key locking principle to the best type of three-jawed chuck. This was accomplished by cutting gear teeth upon the edge of the sleeve and drilling holes in the chuck body into which a toothed key may be inserted. By the insertion of the toothed key into one of these holes and revolving the key, powerful force may be applied to revolve the sleeve. As the axis of the key is at right angles to that of the spindle, the force applied to revolve the key is not inclined to revolve the spindle.

Thus it will be seen that the Jacobs chuck possesses the following desirable features: shape, construction, keeping true, quick adjustment and powerful grip. That these claims are substantiated in practice is proven by the fact that this chuck is now being bought exclusively for the drilling department of many of the largest and most progressive manufacturing concerns. It is also used by many manufacturers of drilling ma-

JACOBS IMPROVED DRILL CHUCK.

chines as the chuck equipment for electric, pneumatic and flexible shaft drills, and for drill presses.

This chuck is made in five sizes and is manufactured by The Jacobs Manufacturing Company, of Hartford, Conn.

Preservation of Submerged and Exposed Timber

The question of timber preservation is becoming of more importance every day not only on account of the increasing cost of every kind of lumber, but also on account of the high cost of labor, the actual labor cost of replacing decayed timber being a very serious item. One of the valuable preservatives now on the market is the Teredo Proof & Wood Armor Paint, manufactured by the Teredo Proof Paint Company of 17 Battery Place, New York. This compound is not by any means a new preparation as it has been manufactured in the south for over ten years, and during that time its principal market was in the south, being used both for timber preservation and for protecting submerged wood, such as piling, etc., against the teredo worm.

The paint has given such perfect satisfaction in the south where all will agree that the life of untreated wood is very short, that it stands to reason it would give satisfaction in any state in the Union.

Piling in the Gulf of Mexico, which were treated with Teredo Proof Paint were in good condition after being in service for five years, while untreated piling driven at the same place two years later were practically destroyed at the time the inspection was made. Naturally for this class of work the piling must be dry in order to absorb the paint and the company recommends at least three or four coats. Even then the cost will not exceed ten to twelve cents per lineal foot, which will include all material and labor for appying same. For the painting of dredges, lighters, etc., which, of course, cannot be allowed to remain on the shipways for a sufficient time in which to become dry, the company recommends two coats one coat to be applied immediately after the first coat is completed, when the vessel can be immediately placed in the water, even if the paint is not dry, as it will not wash off. As proof of the value of this paint for this purpose the company states that they know of a government dredge which has been regularly treated with Teredo Proof Paint for nearly ten years and that it has never yet been necessary to replace any of the hull planking. They also report that they have recently received word from the Peninsular & Occidental S. S. Co. of Key West that a lighter belonging to that company was found to be in perfect condition after one year's constant use, although it had only received one coat of paint. It is claimed that a treatment once a year will keep floating equipment free from teredo for an indefinite time.

It is for the protection of exposed timber, however, that this paint should appeal very strongly to railroad engineers and, as it has evidently stood the most severe of all tests, namely the test of time, it would be to their interest to write the company for full particulars regarding it. In a pamphlet recently issued by this company appears a letter from the roadmaster of an electric railroad in the state of Florida, stating that ties which had been treated with their compound were found to be in perfect condition after being in service for over eight years. It appears that no stronger proof could be given of its superior qualities, as the climatic conditions that obtain in that state are particularly destructive to all kinds of timber where the usual life of untreated ties does not exceed more than about three years.

The company claims that ties can be treated at a cost of about fifteen cents each, which is certainly small, considering the results that can be obtained. The compound possesses great penetrating qualities and in addition has a heavy pigment which, being moisture proof, protects the preservative properties that have penetrated into the wood.

The paint has been sold in China, Siberia, Ceylon, Australia, Costa Rica, Trinidad, Guatemala, Newfoundland, Cuba, Barbadoes, so that it appears its merits are being appreciated in foreign countries as much as they are in this country, and the company has among its customers some of the largest commercial firms and railroads in the country, not to mention the United States government, with one department of which, the Engineer Department, they have been doing business for nearly ten years.

Trade Notes

Ward-Parker Supply Company, St. Paul, Minn., has been incorporated with a capital stock of $15,000 to manufacture railway supplies.

Union Switch & Signal Company, Swissvale, Pa., has declared the regular quarterly dividends of 3 per cent for the common and preferred stocks, payable on January 10.

Expanded Metal & Corrugated Bar Company's product, the Johnson corrugated bar, has been awarded the gold medal by the jury of awards of the Jamestown exposition. This is the fourth gold medal that the corrugated bar has been awarded, the last one having been given at the International exhibition at New Zealand.

S. T. DeLaMater, engineer, formerly with The Standard Construction Company, of Chicago, has been engaged by The General Fireproofing Company, and for the present is located at home office in Youngstown, Ohio. Mr. DeLaMater is graduate of Cornell University, 1900, and through his connection with a large number of contracting firms has acquired a wide experience in reinforced concrete design and construction. Among his connections have been Osborne Engineering Company, Cleveland, Ohio; Paul F. P. Mueller, Falenau Construction Company, Standard Construction Company, Chicago, and L. P. & J. A. Smith Company, of Cleveland.

Rail Joint Company, New York, reports that from present indications the outlook for business in the coming year is good and that the company is hopeful of continuing its large output in 1908. The company makes the following statement showing the growth and scope of its business. The Rail Joint Company is the exclusive maker of base-supporting rail joints and is the largest producer of rail joints in the United States. The application of its product to both steam and electric railroad use is growing in popularity all over the world During 1907 the output of the company was in excess of any previous year. All the various types manufactured by this company for standard and special rail sections, also the step or compromise and insulating rail joints, have the greatest amount of contact bearing surface and that fact eliminates the destructive features which are commonly known in weaker appliances. The application to T and girder rails for steam and electric railroad use has become general. The general aggressive policy of the company has been fruitful of highly creditable results, as in the development of its business it has reached out and broadened until its products are known in all railroad centers. It has had in view the acquainting of those interested with the fact that its product is representative of the furthest point of progress that has been made to date in the rail joint industry, a fact which is well exemplified by the increasing business that the company now enjoys. In the contract of the Panama Railroad the government engineers approved of the continuous type for the entire work, and the best engineers in the United States, also in Japan and other foreign countries, have done likewise.

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